Poeciliid Models for Biological Invasions

Kit Magellan

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Key focus: Common traits in invasion success

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- Neophilia ⟷ Neophobia

Key focus: Common traits in invasion success

- Invasions are highly context dependent
  - Species; Ecosystem; Habitat; Community; Climate…
    - Generalizations are rare

- Behavioural flexibility enhances invasion success

[Magellan et al (2019) Aquatic Invasions 14: 502-517
Sol & Weis (2019) Aquatic Invasions 14: 551-565]

Key focus: Common traits in invasion success

- Narrow the focus
  - Examine a single model species/group of species
    - See what common traits emerge in different contexts

Behaviour and Invasions Special Issue
Aquatic Invasions

Behaviour and Invasions Special Issue
Aquatic Invasions

5 out of 13 submissions
Poeciliidae

Aquatic Invasions (2019) Volume 14, Issue 3: 412–416

Special Issue: Behaviour in Aquatic Invasions
Guest editors: Kit Magellan, Amy Deacon, Marian Wong and Mhairi Alexander

Foraging behaviour of a native topminnow when shoaling with invaders

Morelia Camacho-Cervantes[1], Vianey Palomera-Hernadez[1] and Constantino Macías García[2,*]

Predatory behaviour of female guppies (*Poecilia reticulata*) in a mosquito control context: the importance of social and habitat factors

Amy E. Deacon[1,4,*], Susanta K. Ghosh[2], Anuradha Bhat[3] and Anne E. Magurran[4]

Personality-dependent survival of the invasive mosquitofish: being social can be deadly

Tomas Brodin[1,2,*], Sean Fogarty[1], Andrew Sih[1] and Julien Cote[1,3,4]

Temperature effects on exploratory behaviour and learning ability of invasive mosquitofish

Kit Magellan[1,2,*], Timothy C. Bonebrake[1] and David Dudgeon[1]

Behaviour and Invasions Special Issue
Aquatic Invasions

Behaviour and Invasion papers

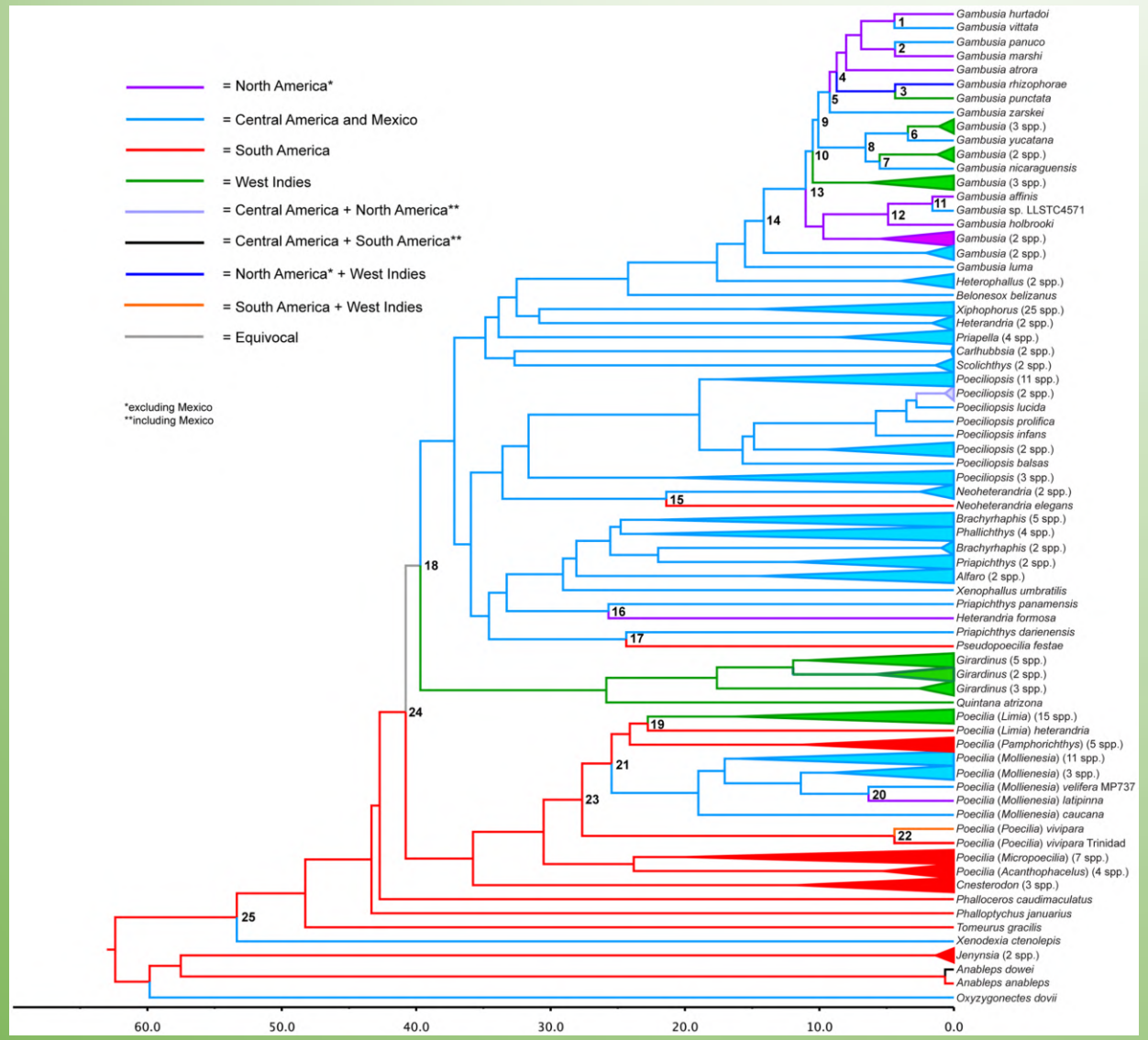
https://www.reabic.net/aquaticinvasions/2019/issue3.aspx

Family Poeciliidae

Family Poeciliidae

- Small fish
- ~ 250 species (349: Fishbase)
- Native to Americas

Family Poeciliidae



Reznick et al (2017) The origin and biogeographic diversification of fishes in the family Poeciliidae. PLoS ONE 12(3): e0172546.

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- aka live-bearing toothcarps
  - Internal fertilization
  - Viviparous

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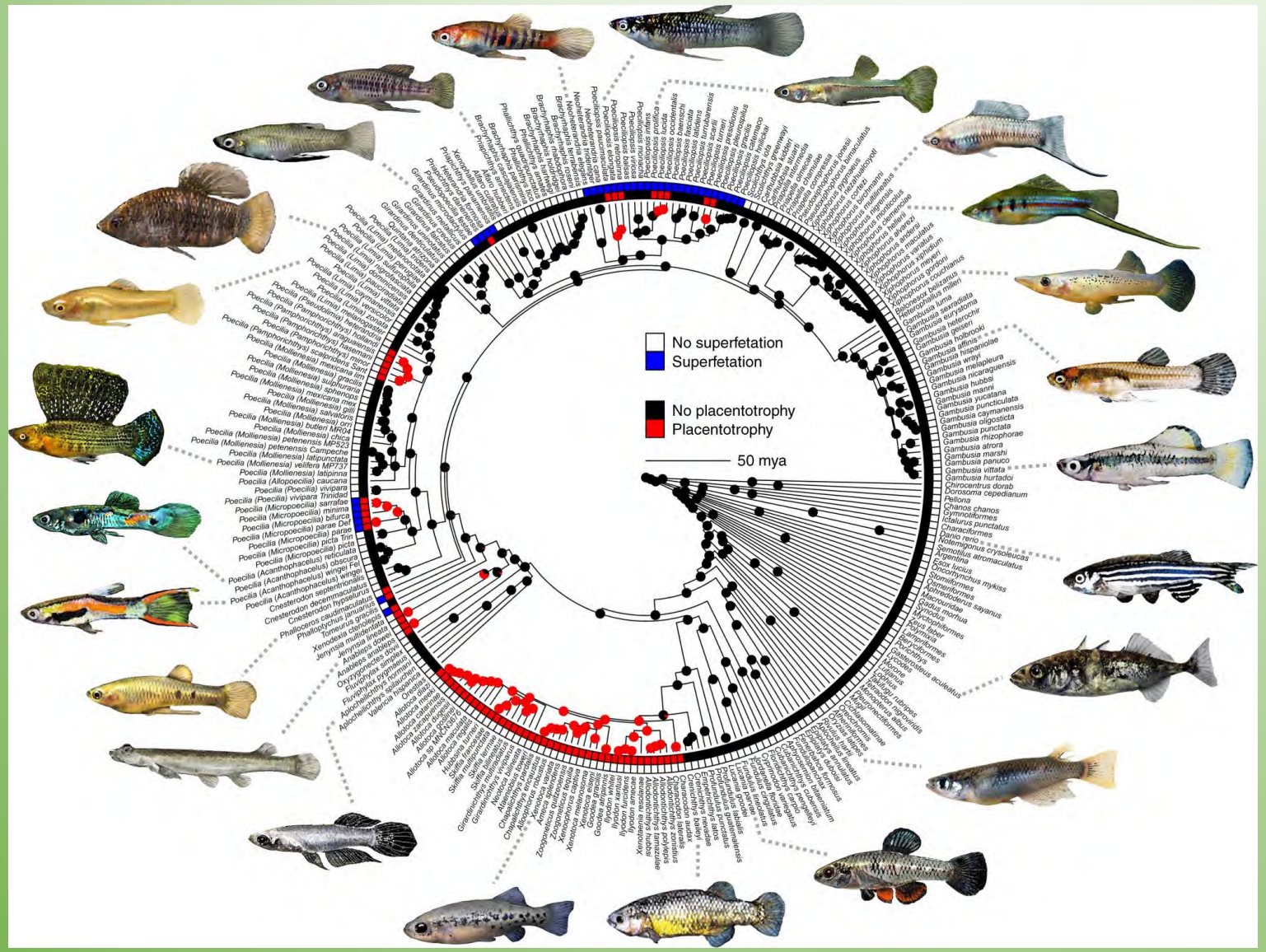
- Small fish
- ~ 250 species (349: Fishbase)
- Native to Americas
- aka live-bearing toothcarps
  - Internal fertilization
  - Viviparous
- Several well known invasives
  - Mosquitofish (world's 100 worst)
  - Guppy

The Poeciliidae



Furness et al (2019) How conflict shapes evolution in Poeciliid fishes.
Nature Communications 10: 3335

Family Poeciliidae

Model species for invasions???

Quick Lit Review

How Poeciliid fishes contribute to invasion science

Quick Lit Review

How Poeciliid fishes contribute to invasion science

- Google Scholar
- 1st 5 pages
  - invasi* +
    - Poecili*, Gambusia, Xiphophorus, guppy, mosquitofish, swordtail, molly
- English Language
- Easy to access

Quick Lit Review

- Invasi* +
  - Poecili* [5,910]
  - Gambusia [11,900]
  - Xiphophorus [3,780]
  - Guppy [49]
  - Mosquitofish [8,260]
  - Swordtail [2,350]
  - Molly [17,900]
- Cut: non-relevant, theses, conference presentations, repeats

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88 articles

- Cut: non-relevant, theses, conference presentations, repeats

Overview

Overview

Broad Metrics

Overview

Broad Metrics

- 22 countries, 6 continents

Overview

Broad Metrics

- 22 countries, 6 continents
- Types of study
  - Experimental – 32 (36%)
  - Survey – 14 (16%)
  - Survey + analysis – 24 (27%)
  - Model – 3 (3.5%)
  - Review – 9 (10%)
  - Genetics – 3 (3.5%)
  - Report – 1 (1%)

Overview

Broad Metrics

- Species
  - Multi-species – 10
  - *Gambusia affinis* – 20
  - *Gambusia holbrooki* - 28
  - *G. geiseri, G. hispaniolae* – 4
  - *Poecilia reticulata* – 14
  - *P. Mexicana, P. gracilis, P. latipinna* – 2
  - *Xiphophorus helleri* – 4
  - *X. variatus, X. maculatus* – 2
  - *P. sphenops, Pseudoxiphophorus bimaculatus, Phallocerus caudimaculatus* – 1

Overview

Broad Metrics

- Fields of Research
  - Behaviour – 20
  - Impacts – 15
  - Records/ID – 11
  - Life history– 6
  - Control/management – 6
  - Climate change, thermal tolerance – 5
  - Introductions, trophic level/diet, genetics – 3
  - Reproduction, parasites, community – 2
  - Morphology, prediction, metabolism - 1

Overview

Behaviour

- Fields of Research
  - Personality, dispersal – 4
  - Aggression, competition, predation – 3
  - Habitat preference, predator avoidance, foraging, social – 2
  - Exploratory, learning, activity, reproduction – 1
  - Review

Key focus: Common traits in invasion success

species

methodologies

subjects

interpretation

communities

habitats

ecosystems

factors

invasion stage

Key focus: Common traits in invasion success

The way forward?

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The way forward?

Different contexts

↓

Common traits

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Different contexts

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The way forward?

Common traits
↓
Different contexts

Great Global Gambusia Experiment

Start with likely common trait(s)
Assess the effects of context

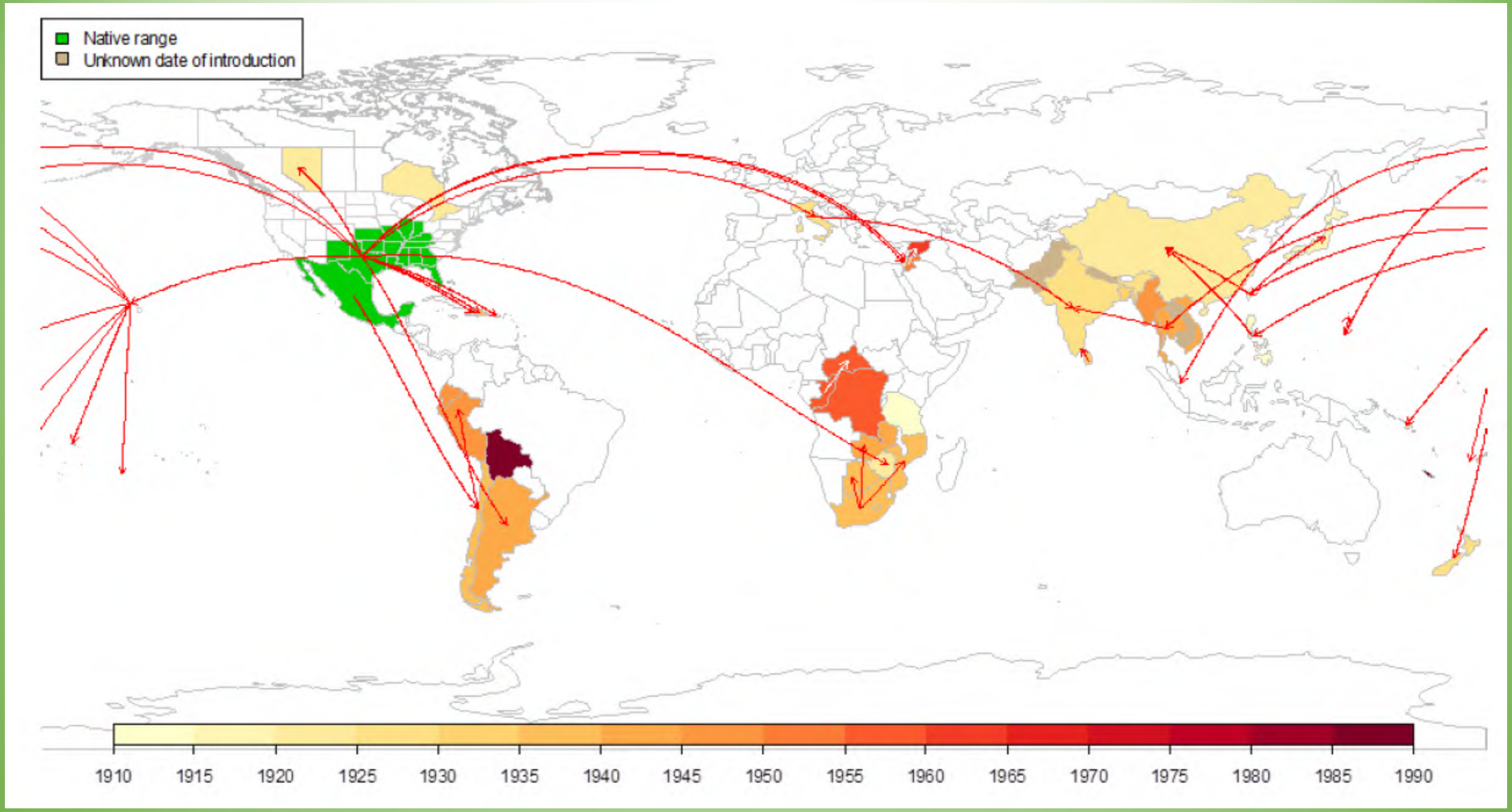
Why Gambusia?

Gambusia affinis

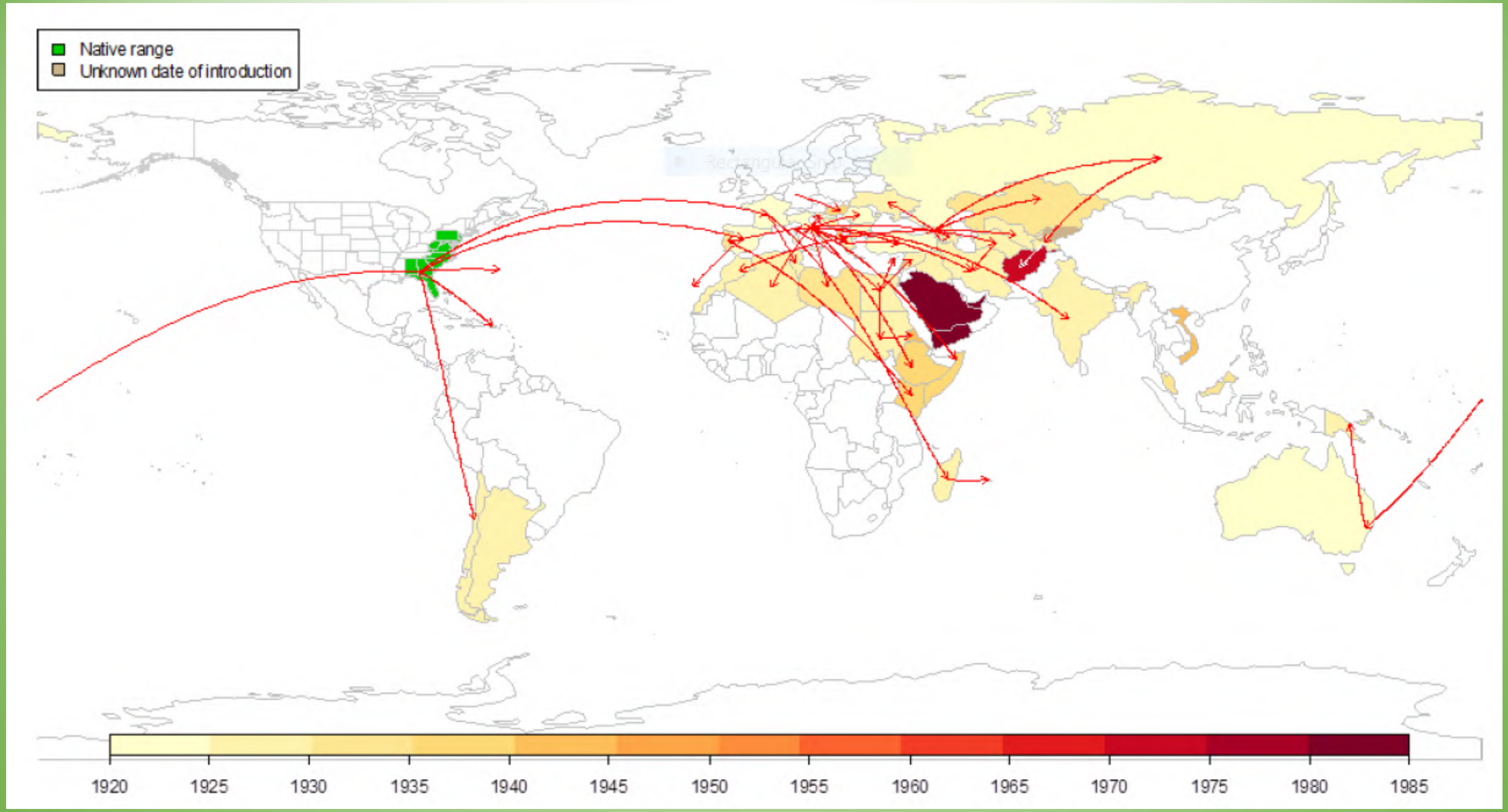
Gambusia holbrooki

Why Gambusia?

- They are everywhere
- Wealth of background information
- Good idea of introduction history



***Gambusia affinis*: SREAN Pao (2015) PhD Thesis: Universitat de Girona**



***Gambusia holbrooki*: SREAN Pao (2015) PhD Thesis: Universitat de Girona**

Why Gambusia?

- They are everywhere
- Wealth of background information
- Good idea of introduction history

- Encourage global cooperation

Cooperation

Cooperation

- Which ‘common trait’?

Cooperation

- Which ‘common trait’?
  - Behaviour
    - Flexibility
    - Neophilia/Neophobia
    - Exploratory tendency

Cooperation

- Which ‘common trait’?
  - Behaviour
    - Flexibility
    - Neophilia/Neophobia
    - Exploratory tendency
  - Criteria
    - Easy to test – simple assay
    - Very easy to replicate
    - Relevant to invasions

Cooperation

Funding???

Cooperation

Interested?

Need access to a *G. affinis/holbrooki* population

Introduced, Native, Lab

kitmagellan@gmail.com

Cambodia


Myanmar
(Burma)
Naypyitaw
Chiang Mai
เทศบาลนคร
เชียงใหม่
Laos
Vientiane
Hanoi
Macau
澳門
Hong Kong
香港
HAINAN
Paracel
Islands
South
China Sea
Thailand
Bangkok
กรุงเทพมหานคร
Vietnam
Cambodia
Pattaya City
เมืองพัทยา
Andaman Sea
Ho Chi
Minh City
Spratly
Islands
Gulf of
Thailand
Map data ©2019 Google


Myanmar
(Burma)
Naypyitaw
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Hanoi
Macau
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LAOS
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Poipet
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Vietnamese Floating Village
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Tonlé Sap
Mekong River
Stung Treng
Pailin
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South China Sea
0 100 km
0 60 miles


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South China Sea


Mainstream dams on the Mekong
Operational dams
Dams under contruction
Proposed dams
400km
200 miles
CHINA
Mekong river
Hanoi
BURMA
Gulf of Tonkin
Xayaburi dam
LAOS
Vientiane
Mekong river
THAILAND
Bangkok
CAMBODIA
Phnom Penh
Ho Chi Minh City
Gulf of Thailand
South China Sea
Source: Challenge Program on Water and Food, Mekong River Commission

Invasion Explosion

Thanks!

Questions & Feedback

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